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New insigths relating to the beginning of the Neolithic in the eastern Spain: Evaluating empirical data and modelled predictions

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ABSTRACT

In this paper we present recent research concerning the neolithization process in the East of Spain, evaluating the time span between the last hunther-gatherer groups and the first farmers (*c.* 5950 −5150 cal. BC). To do that we have compiled and filtered current information about radiocarbon dates and sites in order to discuss the state of the art relating to the models used to explain the Neolithic spread in the region. In this sense we compare archaeological data with recent results of virtual model (ABM) in accordance with the scenarios and mechanisms proposed. On this basis we evaluate the empirical data relating to the current model for explaining the Neolithic spread at the region, a mixed model that consider the coexistence between demic and cultural diffusion processes. Finally, the evaluation proposed considers the benefit of introducing the theoretical approaches relating to the Evolutionary Theory and Complex Adaptative Sistems in order to better understand this crucial process in human evolution.

1. Introduction

The Western Mediterranean region, considered in a wide sense from southern Italy to Portugal and northern Africa, has been studied as a single archaeological unit taking into account the diagnostic features of Early Neolithic contexts, summarized in the spread of *Cardium-Impressed* pottery wares. There is a general consensus regarding the origin of these wares in southern Italy, but the debate about the mechanism by which the process spread to the west, particularly to the Iberian Peninsula, remains open. As has already been pointed out, this area is a privileged region for analysing the spread of agricultural groups (Bernabeu Aubán and Martí Oliver, 2014; Zilhão, 2003) due to its geographic location and the persistence of Mesolithic groups (*post quem c.* 6000 cal. BC).

To date, most efforts to understand the Neolithic expansion have been made on a European continental scale, using dates (radiocarbon database) and places (first Neolithic sites) as the key variables to evaluate the viability of a demic expansion. Most of these have been developed as formal mathematical models, the most prevalent being a mathematical representation of an advancing wave front (Steele, 2009) based on the seminal work provided by Ammerman and Cavalli-Sforza (1984).

In the past 15 years, the availability of inexpensive, high-speed computer processing and a greatly expanded radiocarbon database has led to a number of studies that have revisited the empirical comparisons of demic diffusion proposed by Ammerman and Cavalli-Sforza (1984), using different approaches such as time-delay, role of waterways, boundaries and cultural items (Ackland et al., 2007; Bocquet-Appel et al., 2009; Davison et al., 2009, 2006; Fort et al., 2012; Fort and Méndez, 1999; Gkiasta et al., 2003; Pinhasi et al., 2005).

The bulk of information concerning the Western Mediterranean in these studies has been somewhat sparse. More recently, new approaches especially concerning the Iberian peninsula (Bernabeu Aubán et al., 2015; Fort, 2015; Isern et al., 2014, 2017), have substantially modified this view. Some of these works apply new approaches based on Agent Based Modelling (ABM). Using different simulation procedures and models, they conclude that the variability of the empirical record seems to be better explained by a mixed process including both colonization and 'acculturation' with some degree of regional variation. On the other hand, the possibility of a double way of expansion (northern, via southern France; and southern, via North Africa) still remains an open question.

In this sense, the resulting scenarios of those ABM (Bernabeu

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Aubán et al., 2015; Pardo Gordó et al., 2015) that best fit the archaeological record could equally be explained by a) temporally equivalent arrivals of farmers spreading along the Mediterranean coast of Europe by land, and other settlers arriving by boat from Africa; or, b) farming groups spreading along the Mediterranean coast by sea at several places over a short period of initial colonization (i.e., simultaneous within the resolution limits of radiocarbon dating; see Isern et al., 2017), followed by a lengthier period of land-base dispersals inland from each initial coastal settlement (Zilhão, 2001). Interestingly, recent researches focused on material culture items to identify spatio-temporal patterns of variability compatible with colonization scenarios (Pardo Gordó, 2015) suggest that this variability, measured as diversity in pottery decorations, could largely be the result of some kind of colonization process in most of the Iberian Mediterranean regions. This, in turn, seems to be compatible with other empirical research (Bernabeu Aubán et al., in press; García- Martínez de Lagrán, 2015).

Moreover, these works offer insights about local-decision making that resulted in the large-scale dispersal of agriculture in Iberia. The best scenarios were those using rules for the establishment of new farming communities that avoided already settled regions, sometimes by moving up to 100 km, and preferring the highest quality land available, completely avoiding land that was even slightly marginal for growing wheat (Bernabeu Aubán et al., 2015; Pardo Gordó et al., 2015). This is also consistent with the nature of archaeological evidence for early Neolithic settlement across Iberia, dominated by small hamlets or farmsteads (for a state-of-the-art in Iberia see Rojo et al., 2012). In all these studies, the East of Iberia seems to be a key region to understand both: the origin of pioneering agricultural groups, and the possibility that those groups reached Iberia through different routes.

Our contribution aims at presenting and evaluating the impact of this new evidence on the broader issue of the neolithization. The next section will evaluate the quality of the relevant evidence – radiocarbon dating, archaeological sites – upon which the other sections are based. The subsequent sections will describe the situation in the Eastern region of Iberia at three specific moments: the Late Mesolithic (*c.* 5950–5650 cal. BC), the Neolithic expansion (*c.* 5650-5450 cal. BC) and consolidation (*c.* 5450–5250 cal. BC). The final section will focus on the end of the Early Neolithic as well as some of the demographic, economic and social dynamics behind the processes described.

2. Regional settings: mannaging the evidence

The eastern Iberian territories offer highly varied landscapes encompassing mountainous inland areas (the Iberian mountain ranges in the north and centre area and the Prebetic mountains ranges in the south), and the coastal platform between the Ebro and Segura estuaries. The region is thus characterized geographically by the contrast between abrupt mountainous areas and a variable littoral extension. Coastal plains and natural corridors along the main rivers constitute the routes that connect different territories, facilitating coastal and inner contacts.

The neolithization process took place during the Atlantic chronozone, a period coincident with the Holocene climatic optimum. The climate corresponds with a Mediterranean type with mild winters and warm and dry summers and a mainly dry precipitation regime (annual precipitation: 350–600 mm). If we consider the regional and micro-regional levels, main paleoclimate events described in a general scale (8.2 and 7.1 events cal. BP, or 6.2 and 5.1 cal BC) could have affected paleo-ecological conditions, but in a manner not clearly defined. The great expansion of oak and the upward migration of *pinus* sp characterizes ecological landscapes, as is observed in charcoal and pollen diagrams (Carrión et al., 2010). The marine transgression process which started at the Early Holocene contributed to the modification of the coastline, with the establishment of some marshy areas in littoral plains (Viñals and Fumanal, 1995).

The radiocarbon dataset of the Late Mesolithic and Neolithic in the region has witnessed an increase in the number of direct dates thanks to the improvement in sample selection protocols (Wood, 2015). Considering the process broadly from *c.* 7000 to 4800 cal. BC (*c.* 8000 to 5500 bp), we have compiled a total of 158 dates with a standard deviation equal to or less than 100, derived from 14 Mesolithic and 33 Neolithic sites and layers (Table 1). This compilation allows us to evaluate the effects of the nature of sample selection on the discussion involved. In this sense, and despite the predominance of charcoal, we can stress the significant number of short-lived samples obtained from domestic or wild species. The key period for understanding the Neolithic spread ranges from *c.* 6000 to 5000 cal. BC (*c.* 7000 to 6000 bp). Table 2 shows the 42 radiocarbon dates coming from this time-range. Here we use only dates obtained from short-lived samples, those we consider more accurate to discuss the problems surrounding the Neolithic Transition in the Eastern Spain. The dates have been calibrated using Oxcal 4.2 program (Bronk Ramsey, 2009) and Intcal curve13 (Reimer et al., 2013).

In accordance with the selected radiocarbon dataset and some reference stratigraphic sequences (Cocina cave, Costalena and Botiquería rock-shelters) the Late Mesolithic period is divided into two phases, characterized by the shape of geometric microliths (see next point). On the other hand, ceramic decoration characterizes the recognized phases of the Early Neolithic in this area; so that the Neolithic sequence could be roughly divided in 3 stages:

1. 5650-5450 cal. BC. Taking into account recent discoveries, this phase is characterized by a major diversity in pottery styles, including cardial decoration, slab and drag ('*sillon d'impressions*' or '*boquique*' in local terminology) and simple impressions made using varied instruments.
2. 5450-5150 cal. BC. This second stage corresponds to the classic cardial world. Despite some changes, this period is dominated by the cardial decoration. Together with cardial, reliefs, commonly decorated with finger impressions, are predominant in decorated pots.
3. 5150-4850 cal. BC. Starting towards the end of the previous phase, this stage is characterized by the development of new pottery stiles. The interesting novelty now is that these styles show a clear spatial distribution in the northern and southern areas of the region.

The map of Fig. 1 has been elaborated using the Mesolithic and Neolithic sequences described above. Although the site distribution

Table 1
Summary of radiocarbon dates from *c.* 8000 to 5500 BP.

	Mesolithic	Neolithic
Charcoal long live	7	48
Charcoal short live	0	1
Seeds/fruits	4	19
Cereal	0	15
Animal bone	19	26
Domestic	0	19
Human Bone	11	12
Shells	0	0
Other	1	2
Indeterminate	0	5
Dates	42	116
Sites	14	33

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